

NASA - Johnson Space Center's New Capabilities for Air Purification

Presentation to be delivered at:
Air Quality Technologies Event
March 26, 2015

Hosted by the Technology Collaboration Center of Houston

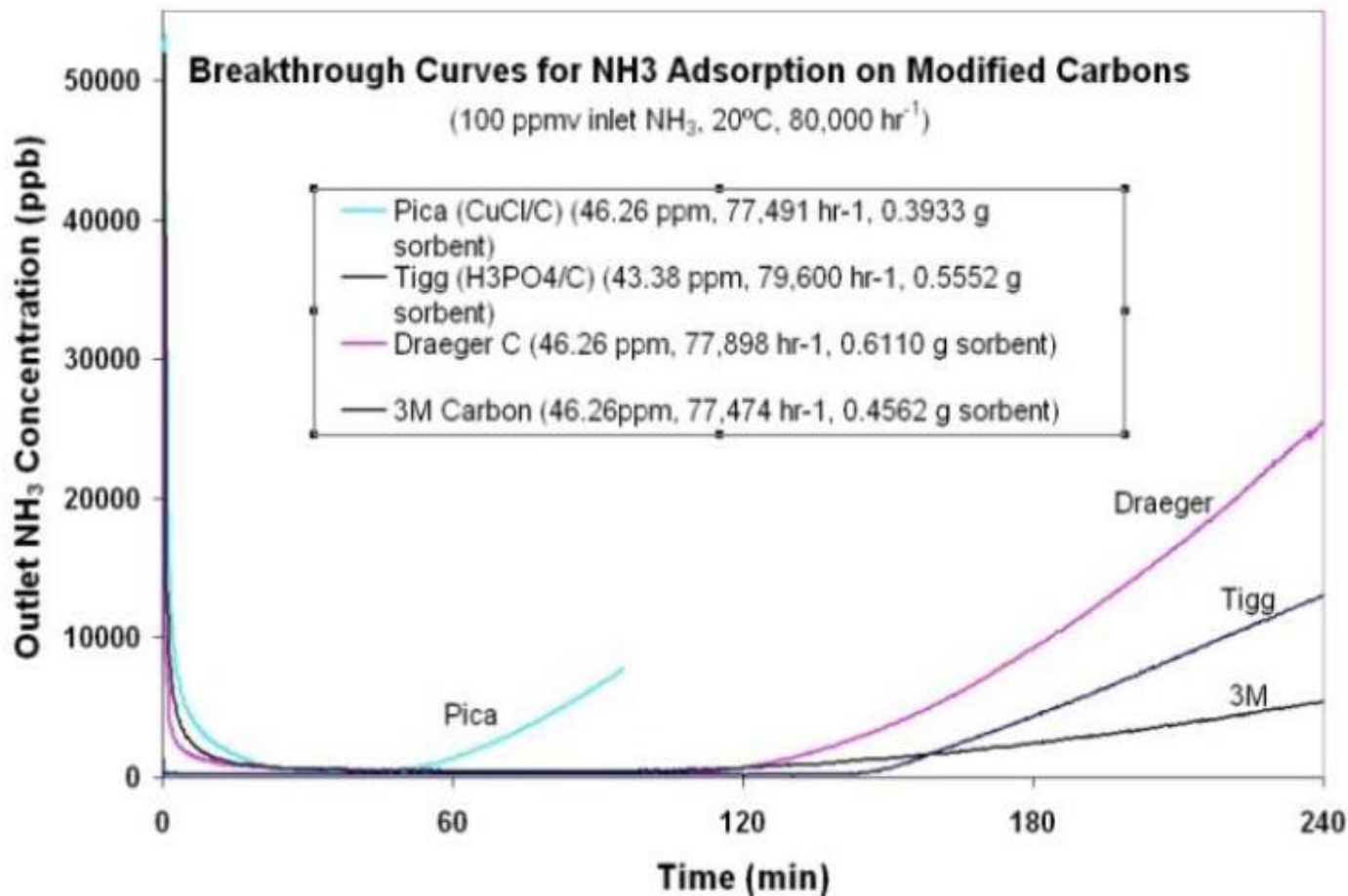
Presented by:
John Graf

john.c.graf@nasa.gov

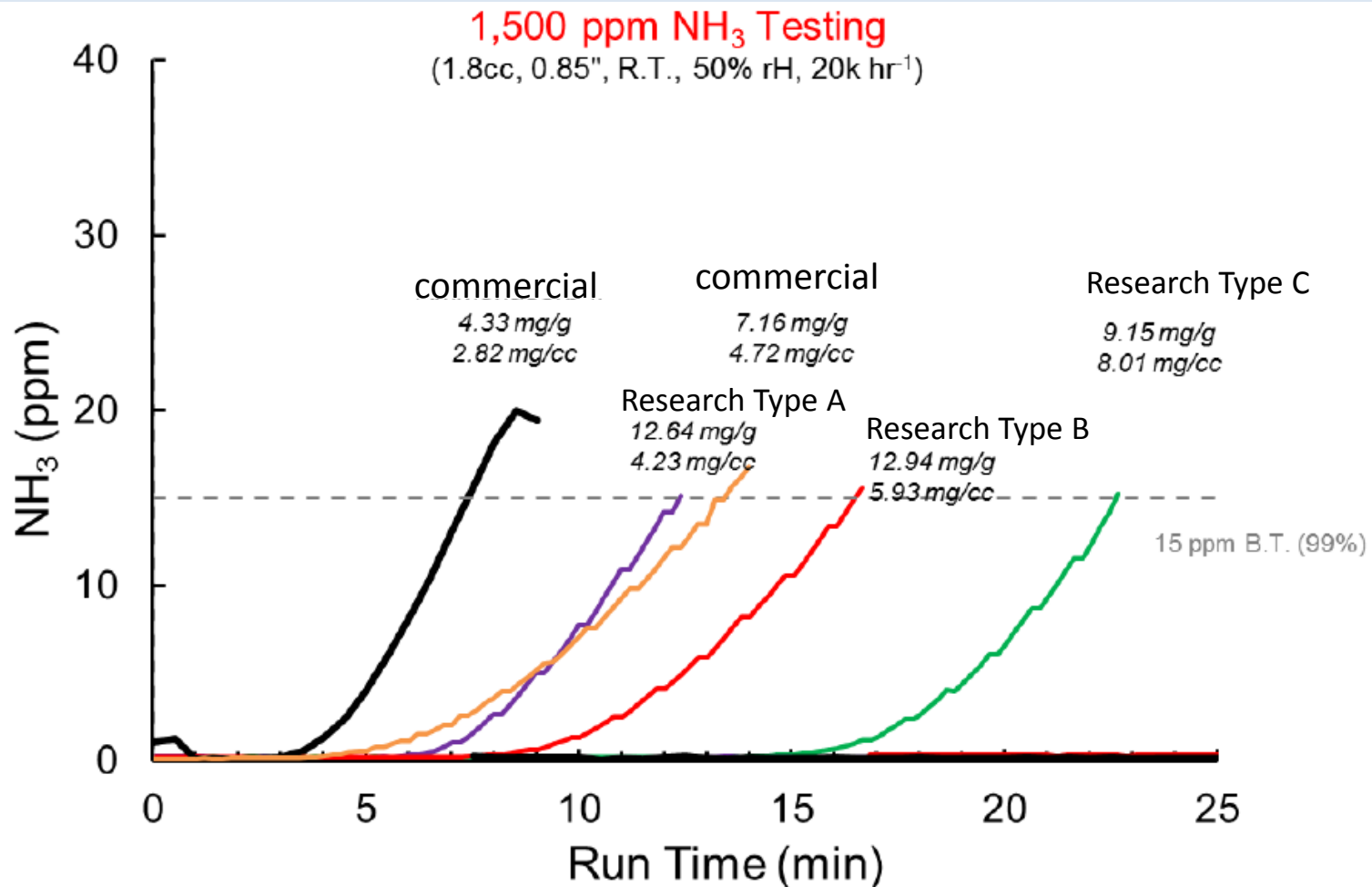
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Summary: NASA has some unique and challenging air purification problems that cannot be adequately met with COTS technology: 1) ammonia removal from air, 2) hydrazine removal from air, 3) CO conversion to CO₂ in low temperature, high humidity environments. NASA has sponsored the development of new sorbents and new catalysts. These new sorbents and catalysts work better than COTS technology for our application. If attendees have a need for an effective ammonia sorbent, an effective hydrazine sorbent, or an effective CO conversion catalyst, we should learn to see if NASA sponsored technology development can help.

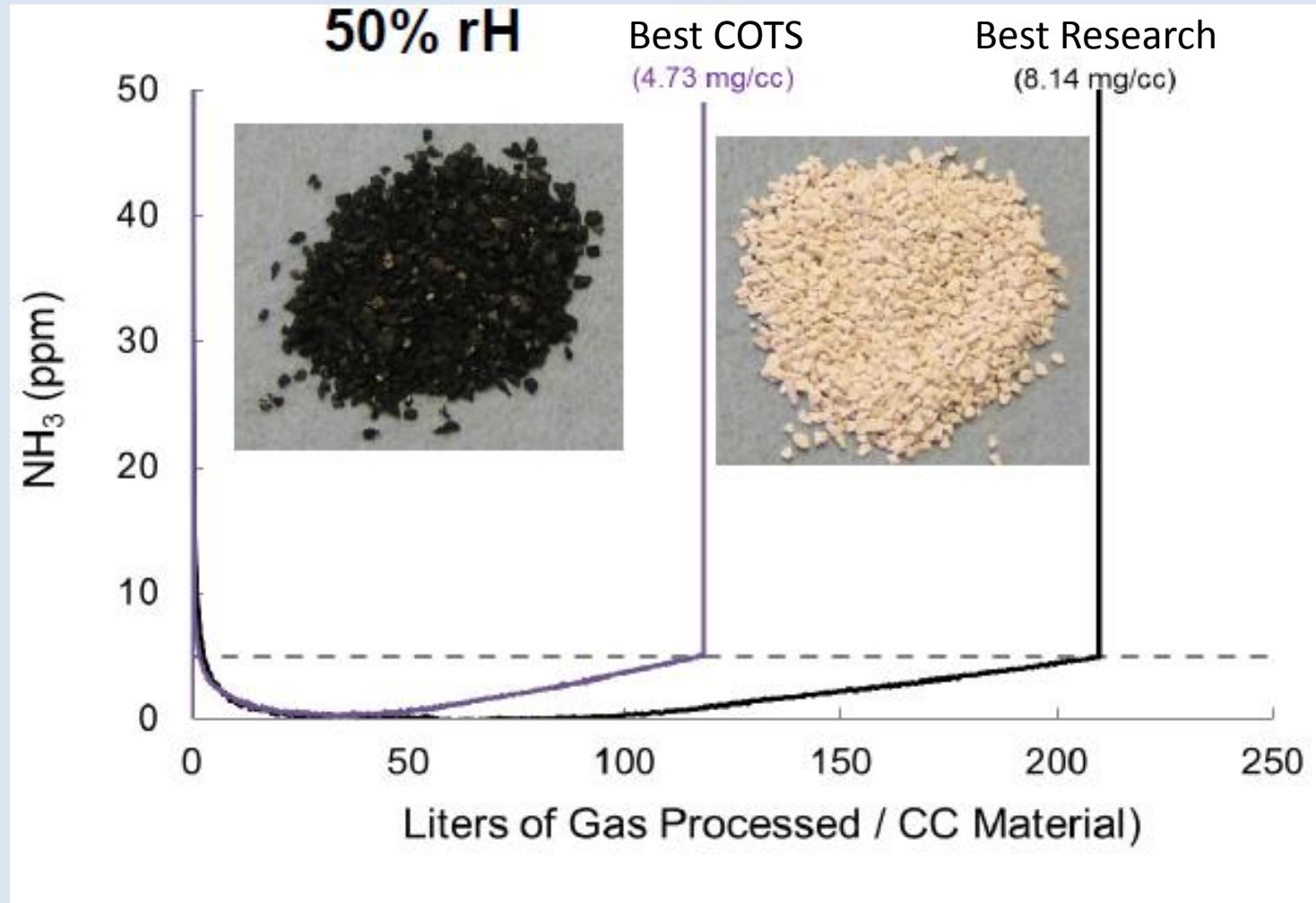
Commercially available ammonia sorbents generally use a high surface area, high porosity sorbent that is treated with phosphoric acid, or copper chloride, or zinc chloride. For screening tests targeting the NASA application, 3M ammonasorb is the best commercially available material.



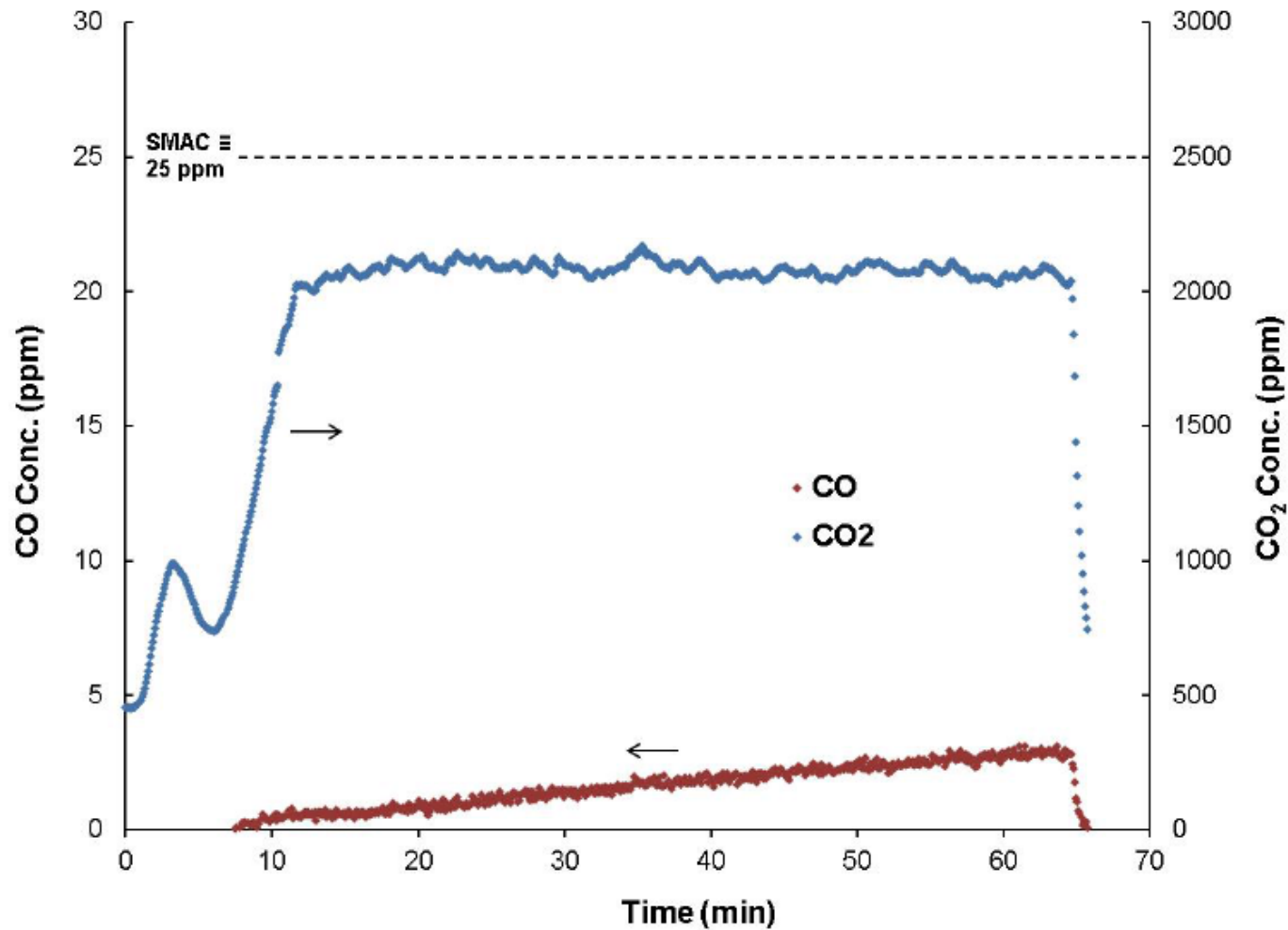
For NASA “fast flow” challenge test conditions, one sorbent developed for NASA had 70% more capacity on a volume basis than the best commercially available sorbent



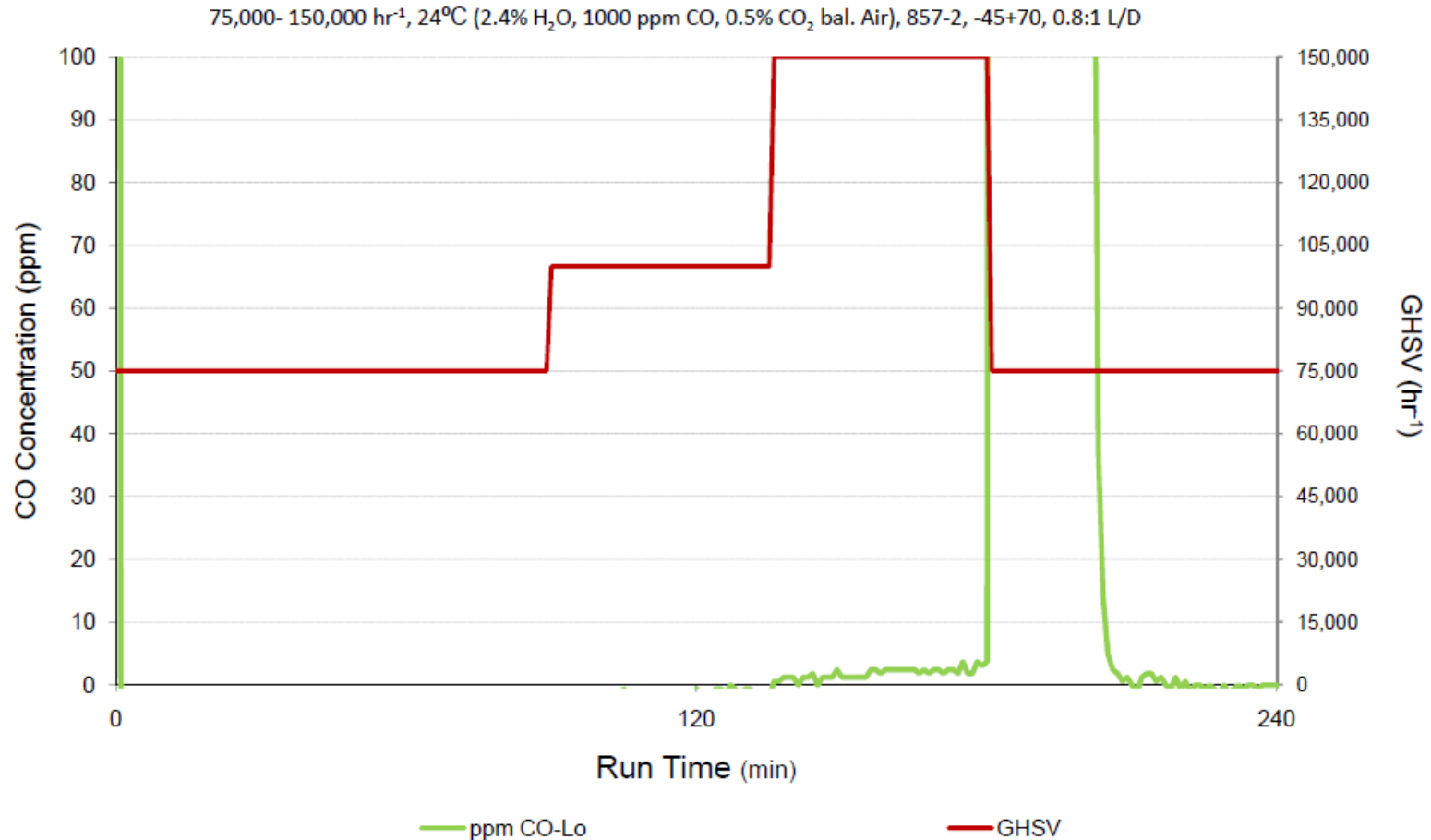
Some sorbents work well in conditions of high relative humidity, but not low relative humidity. Some sorbents work well in low RH but not high RH. The sorbent developed for NASA works well in wet and dry environments



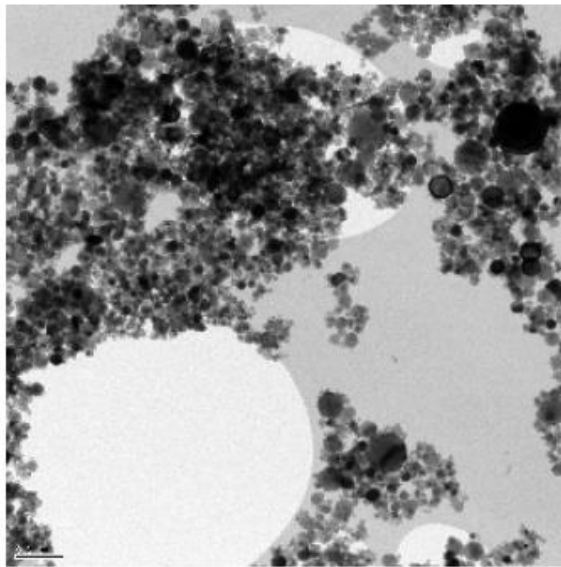
CO is oxidized into CO₂ – inlet CO is 1500 ppm, outlet CO is less than 5 ppm. GHSV = 45,000.



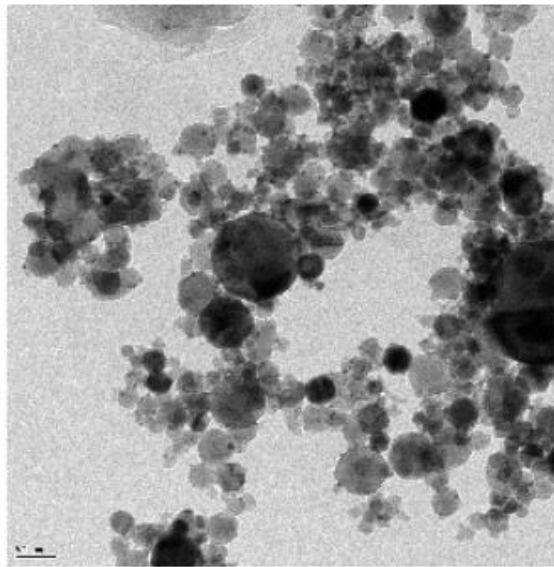
1000 ppm CO in, <5ppm out at 150,000 GHSV



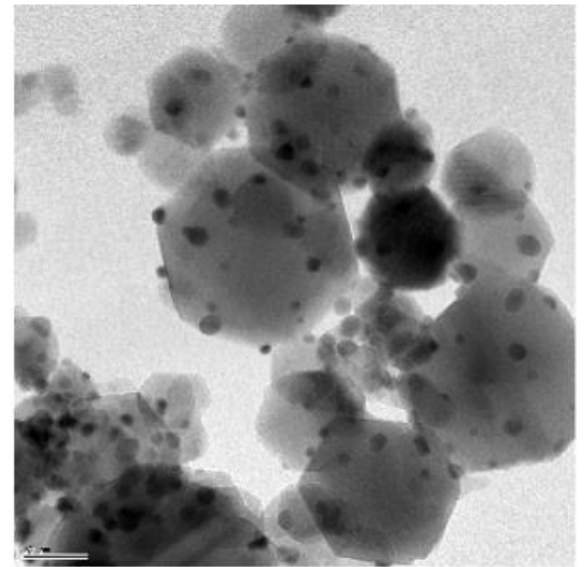
Homogenous alkalization results in many small, uniformly sized, metal clusters



--- 0.2μm

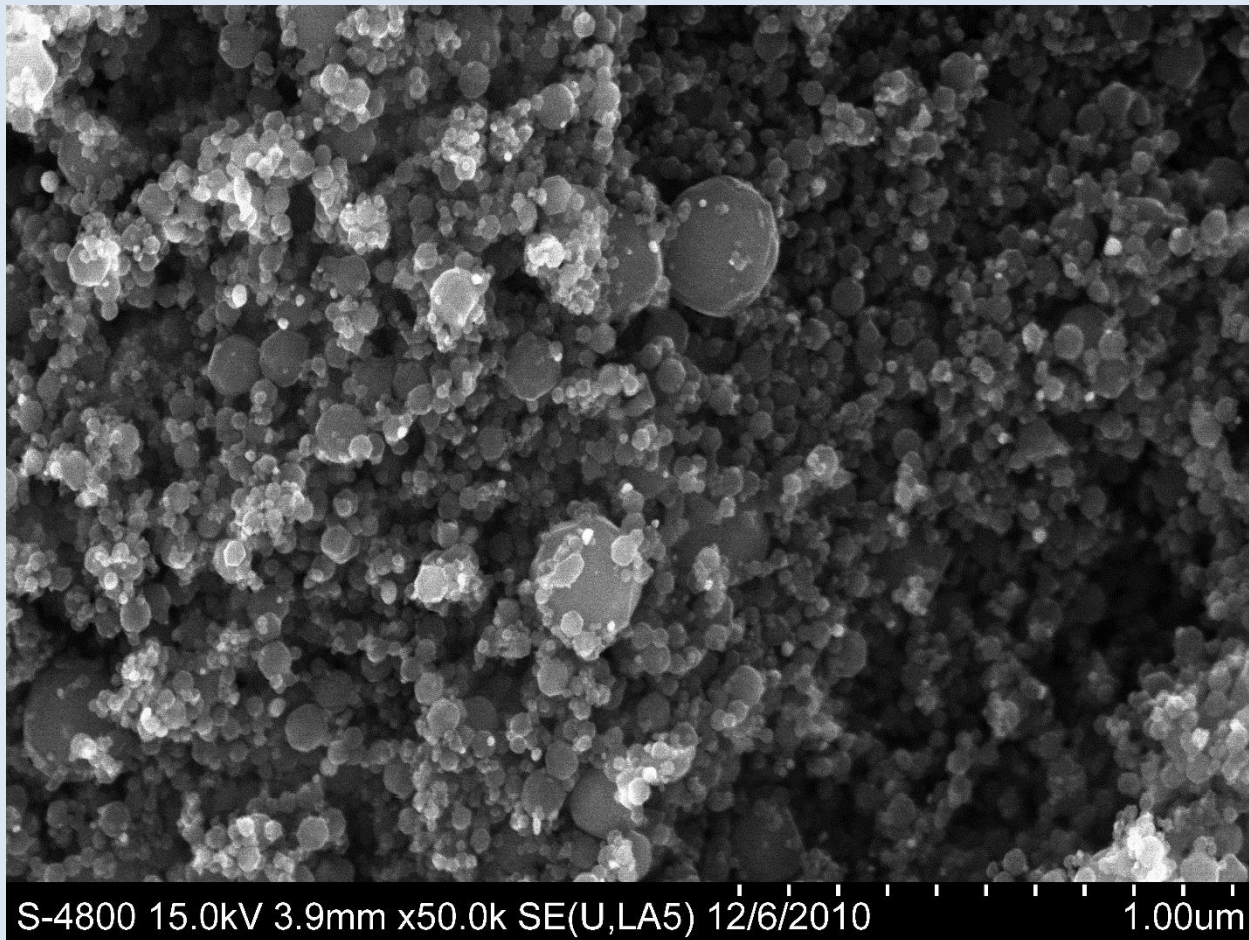


--- 50 nm

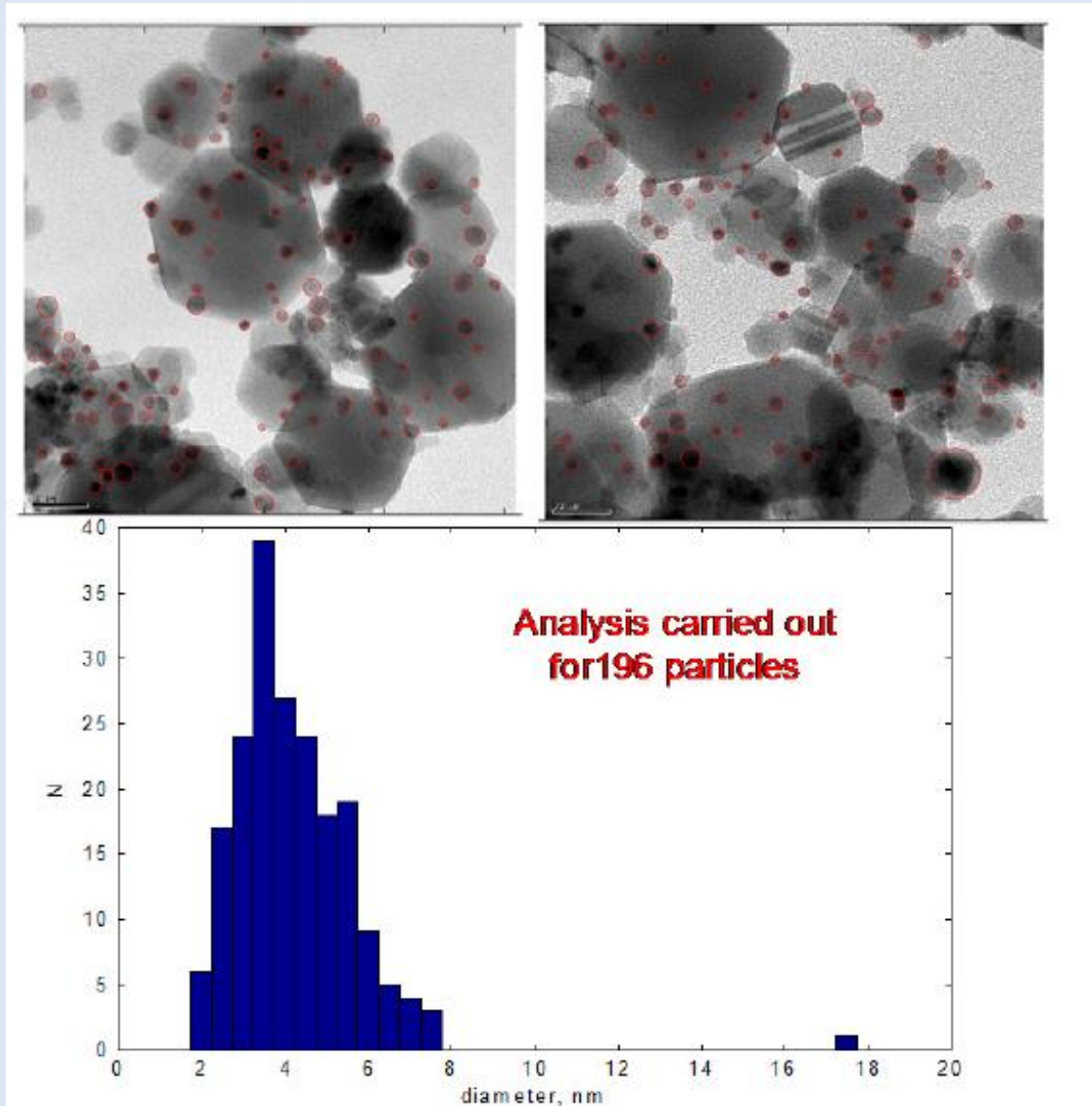


---- 20 nm

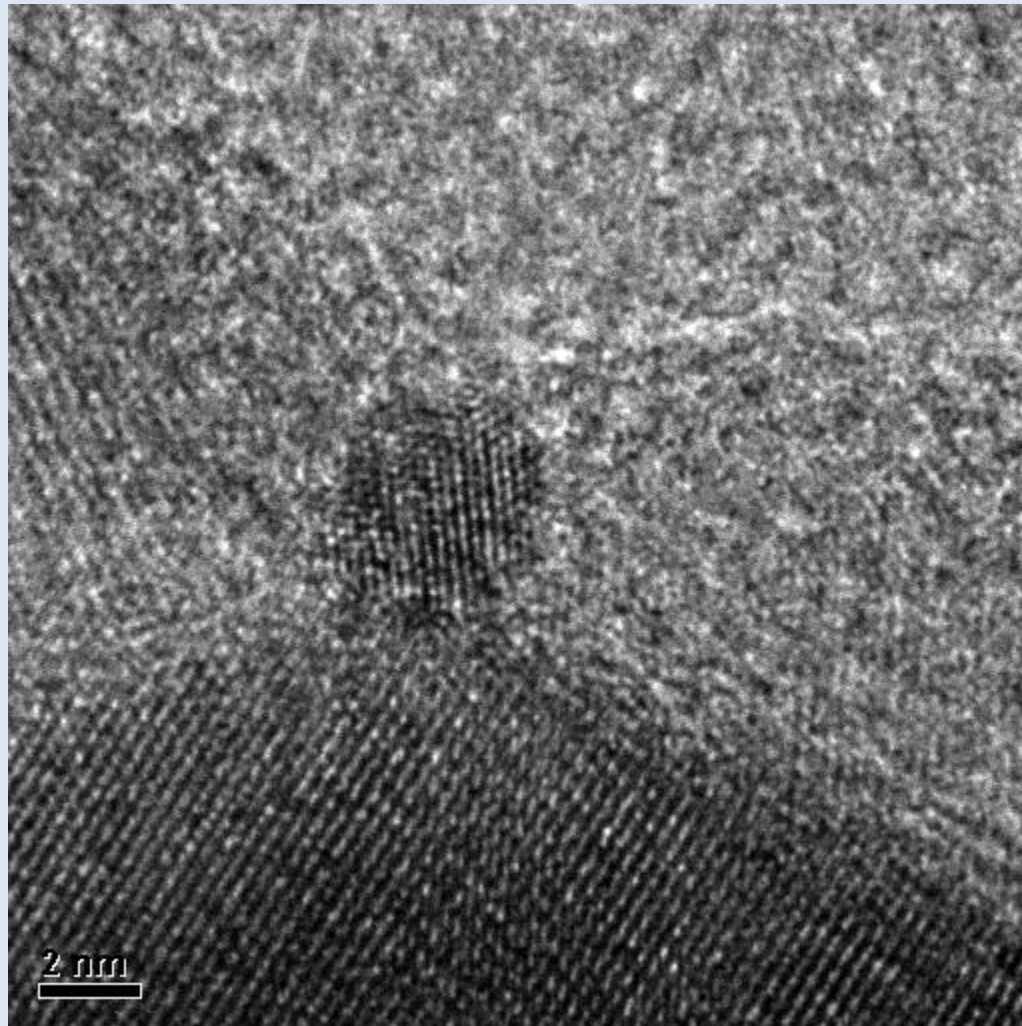
Underlying support and catalyst both play a role in the catalytic oxidation process.



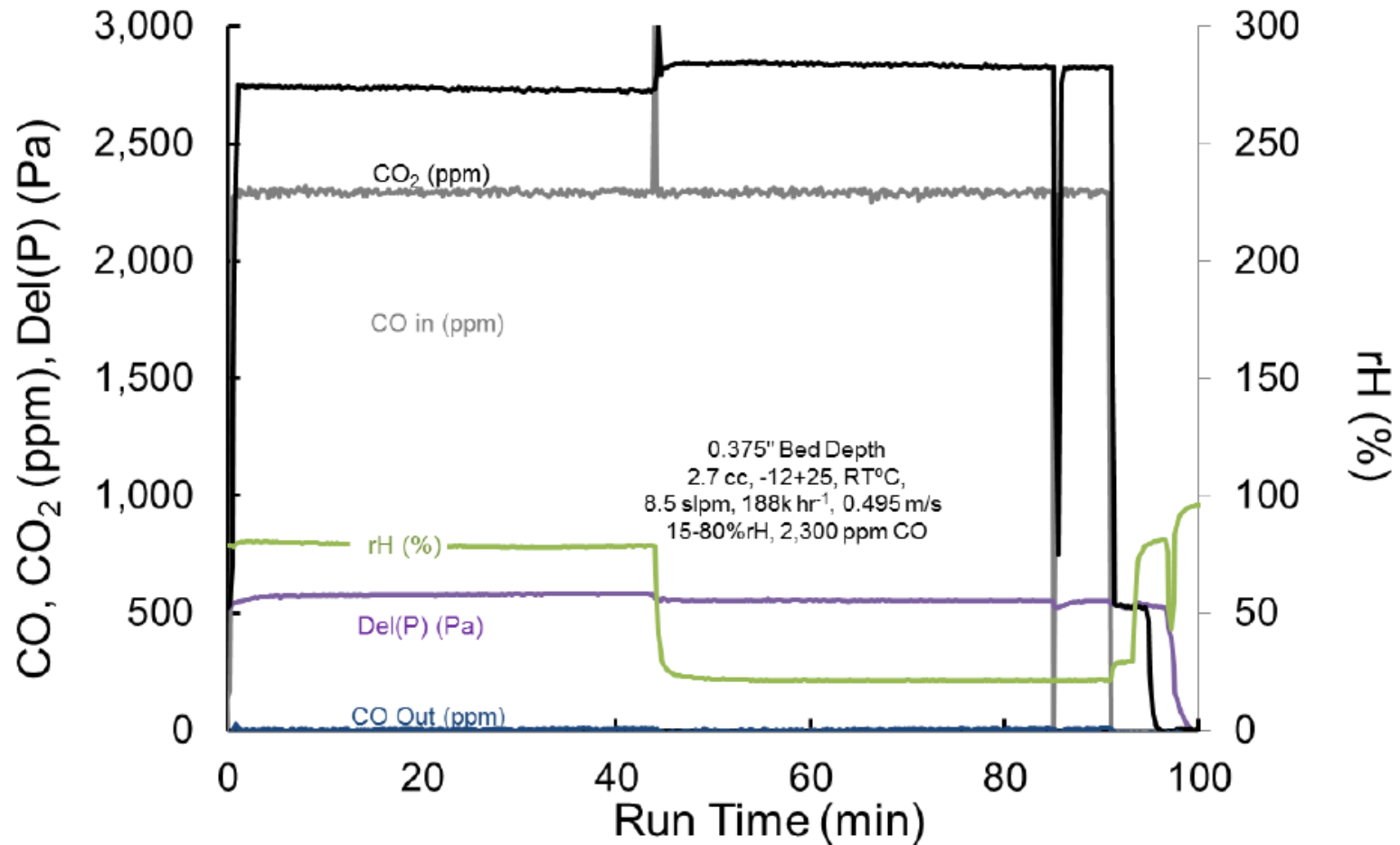
Uniform distribution of many, small catalyst sites is key to performance



TEM image of one metal cluster

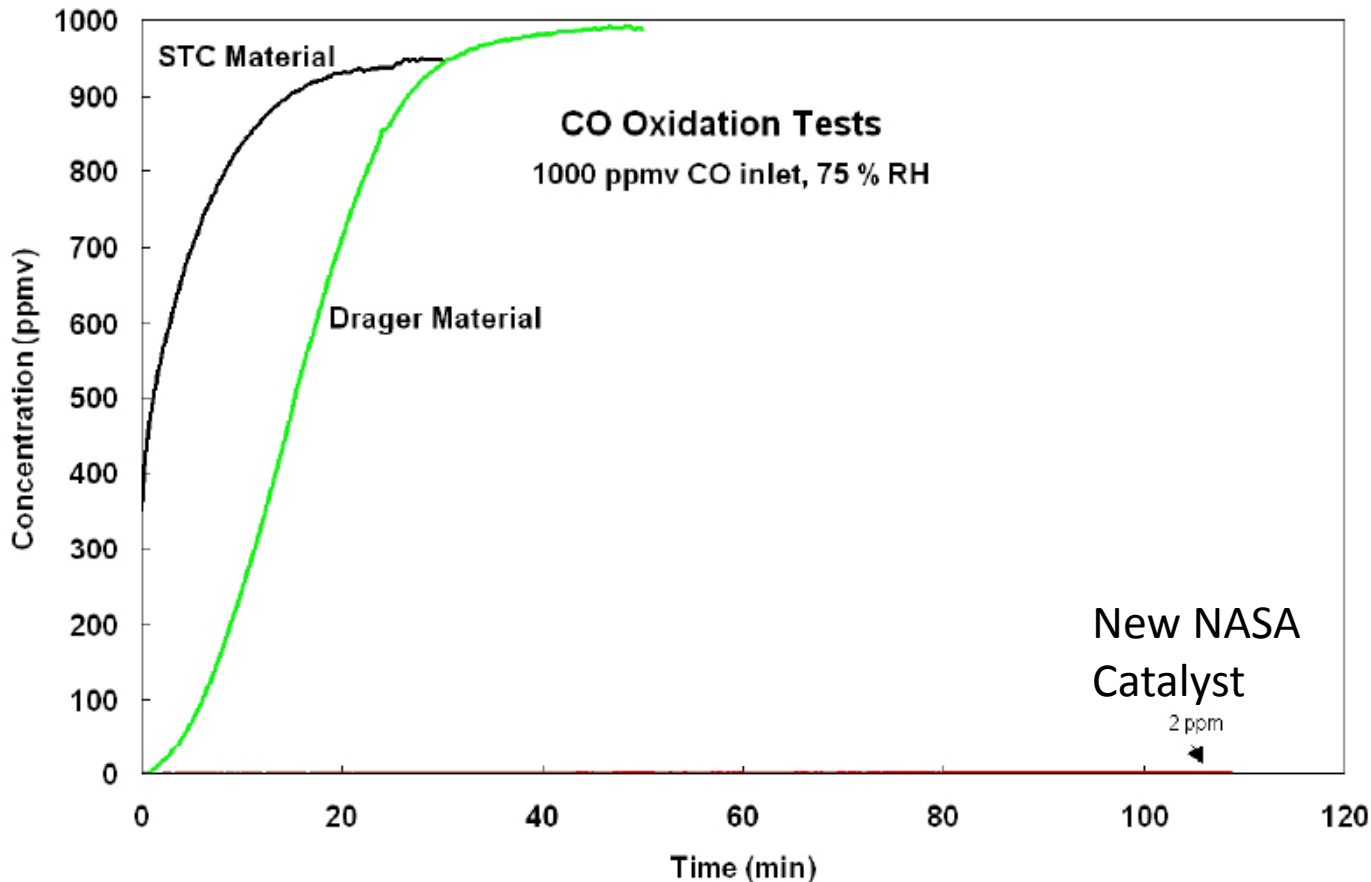


15% to 80% RH – no measurable change in performance



Ammonia eventually poisons this catalyst, but because there are so many more catalyst sites, the presence of ammonia does not affect performance in the NASA Application

T= 20°C, NH₃ Inlet Conc.= 44 ppmv, Relative Humidity= 49% in air, GHSV= 80,000 h⁻¹ (RT= 0.045 sec)



Summary

- If you are looking for a way to remove ammonia from air, and you need better than 5 mg/cc, we should talk.
- If you are looking for a way to remove hydrazine from air, we should talk.
- If you are looking for a way to convert CO into CO₂ at GHSV of >50,000, we should talk

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